## WHAT IS CLAIMED IS:

1	1. A polarization-insensitive integrated wavelength converter comprising:
2	a wavelength converter having first and second input/output ports;
3	a polarization separator having a first port for receiving an input optical signal,
4	a second port providing a first component of the input optical signal in a first polarization
5	mode, and a third port providing a second component of the input optical signal in a second
6	polarization mode, with the second port of the polarization separator optically coupled to the
7	first input/output port of the wavelength converter; and
8	a polarization rotator coupling the third port of the polarization separator to the
9	second input/output port of the wavelength converter that rotates the polarization mode of an
10	optical signal propagating through the polarization rotator.
1	2. The apparatus of claim 1 wherein said polarization rotator comprises
2	an electro-optic half-wave retarder;
1	3. The apparatus of claim 1 wherein said polarization rotator comprises a
2	half-wave plate;
1	4. The apparatus of claim 2 further including a bent waveguide;
1	5. The apparatus of claim 1 wherein said polarization rotator comprises
2	an electro-optic quarter-wave retarder.
1	6. The apparatus of claim 1 wherein said polarization rotator comprises a
2	quarter-wave plate.
1	7. The apparatus of claim 4 further including a mirror.
1	8. The apparatus of claim 1 wherein said polarization rotator comprises
2	an optical fiber having a 90° twist to change the polarization mode.
1	9. The apparatus of claim 1 wherein said polarization rotator comprises:
2	a plurality of light signal propagating paths;
3	wherein said wavelength converter comprises:
4	a plurality of processing channels, each having a second input/output port
5	coupled to a respective light signal propagating path; and

6	wherein said polarizing beam splitter comprises:
7	a plurality of channels coupling the processing channels and light signal
8	propagating paths.
1	10. The apparatus of claim 1 wherein at least a portion of said wavelengt
2	converter comprises a quasi-phasematched structure.
1	11. The apparatus of claim 10 wherein at least a portion of said quasi-
2	phasematched structure is incorporated in lithium niobate.
1	12. The apparatus of claim 10 wherein at least a portion of said quasi-
2	phasematched structure is incorporated in magnesium-oxide-doped lithium niobate.
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1	13. The apparatus of claim 10 wherein at least a portion of said quasi-
2	phasematched structure is incorporated in lithium tantalate.
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1	14. The apparatus of claim 10 wherein at least a portion of said quasi-
2	phasematched structure is incorporated in magnesium-oxide-doped lithium tantalate.
1	15. The apparatus of claim 1 further comprising a waveguide structure.
1	16. The apparatus of claim 15 further wherein said waveguide structure
2	includes a proton-exchanged waveguide.
1	17. The apparatus of claim 15 further wherein said waveguide structure
2	includes an annealed-proton-exchanged waveguide.
_	morados un amientos proton exemungos waveguise.
1	18. The apparatus of claim 15 further wherein said waveguide structure
2	includes a zinc-diffused waveguide.
1	19. The apparatus of claim 15 further wherein said waveguide structure
2	includes a metal-diffused waveguide.
1	20. The apparatus of claim 15 further wherein said waveguide structure
2	includes a titanium-diffused waveguide.
1	21. The apparatus of claim 15 further wherein said waveguide structure
2	includes a buried waveguide.

1	22. The apparatus of claim 15 further wherein said waveguide structur	re
2	includes a reverse-proton-exchange waveguide.	
1	23. The apparatus of claim 1 further comprising an optical circulator	
2	having a port coupled to the first port of the polarizing beam splitter.	
1	24. The apparatus of claim 1 further comprising an electro-optic phase	<b>.</b>
2	modulator for modifying the phase of at least one of the components of the optical signal	
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1	25. The apparatus of claim 1 further comprising an electro-optic phase	
2	modulator for modifying the phase of at least one of the components of the optical signal	l <b>.</b>
1	26. The apparatus of claim 1 wherein input optical signal comprises a	
2	plurality of optical signals.	
1	ν 27. A polarization-insensitive integrated wavelength converter compri	sing:
2	a wavelength converter substrate;	
3	a polarization separator serving to separate an input optical signal into firs	t and
4	second signal components having orthogonal polarization modes.	
5	a polarization rotator serving to rotate the polarization mode of at least one	e of
6	said first and second signal components,	
7	a wavelength converter structure for receiving said signal components and	i
8	generating converted signal components	
1	28. The apparatus of claim 27 in which said converted signal compone	ents
2	comprise a frequency-converted input signal.	
1	29. The apparatus of claim 27 in which said converted signal compone	ents
2	comprise an amplified input signal.	71105
1	30. The apparatus of claim 27 in which said input signal includes a pur	mp
2	signal.	
1	31. The apparatus of claim 27 in which said converted signal compone	ents
2	include a frequency-doubled pump signal.	
1	The apparatus of claim 27 further comprising	

2	an optical circulator structure for providing isolation between the
3	converted signal and an input signal source.
1	33. The apparatus of claim 32 wherein said circulator further comprises
2	a first port coupled to said input signal source for receiving said input optical
3	signal, a second port coupled to said polarization separator, and a third port for providing
4	converted signal.
1	33b. The apparatus of claim 32 wherein said circulator is integrated into
2	said wavelength converter substrate.
2	said wavelength converter substrate.
1	34. The apparatus of claim 27 further comprising an input port for
2	receiving and transmitting one or more input optical signals.
1	35. The apparatus of claim 27 wherein said polarization separator includes
2	a first port for receiving said input optical signal, a second port for transmitting a first
3	component of said input optical signal in a first polarization mode, and a third port for
4	transmitting a second component of said input optical signal in a second polarization mode.
1	36. The apparatus of claim 27 wherein said polarization rotator includes a
2	coupler for providing coupling between said polarization separator and said wavelength
3	converter structure.
1	3 37. A polarization-insensitive integrated wavelength converter comprising:
2	a wavelength converter substrate;
3	a first waveguide, formed in said substrate, capable of supporting both TM and
	TE polarization modes and having first and second input/output ports;
4	
5	a second waveguide, formed in said substrate, capable of supporting at least
6	one of TM and TE polarization modes and having first and second coupling sections disposed
7	near said first waveguide to evanescently couple light signals between said first waveguide
8	and said second waveguide;
9	a reflector coupled to the second input/output port of said second waveguide;
10	a polarization rotator region disposed between the first and second coupling
11	sections;
12	a wavelength converter region formed in at least one of the first waveguide
13	and second waveguide; and

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15	polarization r	otator	region.
1	Ч	38.	A polarization-insensitive integrated wavelength converter comprising
2		a con	verter substrate;
3		a firs	t waveguide, formed in the substrate, having first and second
4	input/output;		
5		a sec	ond waveguide, formed in the substrate, having first and second coupling
6	sections to ev	anesce	ently couple light signals between the first waveguide and the second
7	waveguide (s	upport	ing only TE polarization modes);
8		a pol	arization rotator region disposed on the first waveguide (between the
9	second coupli	ing sec	tion and the second input/output port of first waveguide);
10		a refl	ector coupled to the second input/output port of the first waveguide; and
11			a wavelength converting structure formed in at least one of the first
12	waveg	guide a	nd second waveguide.
1		39.	The apparatus of claim 38 wherein said first waveguide is capable of
2	suppo	rting o	ptical signals having both TE and TM polarization modes.
1		40.	The apparatus of claim 38 wherein said first waveguide includes a
2	metal	waveg	uide.
1		41.	The apparatus of claim 38 wherein said first waveguide includes a
2	buried	l wave	guide.
1	,	42.	The apparatus of claim 38 wherein said first waveguide includes a
2	diffus	ed wav	reguide.
1		43.	The apparatus of claim 38 wherein said first waveguide includes a Zinc
2	waveg	guide.	
1		44.	The apparatus of claim 38 wherein said first waveguide includes a
2	Titani	um wa	veguide.
1		45.	The apparatus of claim 38 wherein said second waveguide includes a
2	proton	-excha	inged waveguide.

a coupler serving to couple said wavelength converter region to said

I	46. The apparatus of claim 38 wherein said second waveguide includes a	ın
2	annealed- proton-exchanged waveguide.	
1	47. The apparatus of claim 38 wherein said second waveguide includes a	ì
2	buried waveguide.	
1	48. The apparatus of claim 38 wherein said polarization rotator includes	a
2	wave plate.	
1	49. The apparatus of claim 38 wherein said polarization rotator includes	2
2	quarter-wave plate.	а
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1 2	50. The apparatus of claim 38 wherein said polarization rotator includes half-wave plate.	a
2	nan-wave plate.	
1	51. The apparatus of claim 38 wherein said polarization rotator includes	an
2	electro-optic wave plate.	
1	52. The apparatus of claim 38 wherein said polarization rotator is	
2	positioned near said first waveguide.	
1	53. The apparatus of claim 38 wherein said polarization rotator is	
2	positioned near first waveguide between said first coupling section and said second couplin	g
3	section.	
1	54. The apparatus of claim 38 wherein said polarization rotator is	
2	positioned near first waveguide between said second coupling section and said reflector.	
1	55. The apparatus of claim 38 wherein said polarization rotator includes	2
2	waveplate inserted into a saw cut in said converter substrate.	а
	<b>,</b>	
1	56. The apparatus of claim 38 wherein said polarization rotator includes	a
2	waveplate fastened to the end of said converter substrate.	
1	57. The apparatus of claim 38 wherein said polarization rotator includes	a
2	waveplate fastened between the end of said converter substrate and said reflector.	

1	58.	The apparatus of claim 38 wherein said reflector serves to reflect said
2	input signals.	
1	59.	The apparatus of claim 38 wherein said reflector serves to reflect said
2	converted signals.	
1	60.	The apparatus of claim 38 wherein said reflector serves to reflect pump
2	signals.	
1	61.	The apparatus of claim 38 wherein said reflector serves to transmit
2	frequency-doubled 1	pump signals.
1	62.	The apparatus of claim 38 wherein said reflector serves to reflect
2	frequency-doubled [	oump signals.
1	63.	The apparatus of claim 38 wherein said reflector serves to transmit said
2	input signals.	
1	64.	The apparatus of claim 38 wherein said reflector serves to transmit said
2	converted signals.	
1	65.	The apparatus of claim 38 wherein said reflector serves to transmit
2	pump signals.	
1	66.	The apparatus of claim 38 wherein said wavelength converting
2	structure includes a	
1	67.	The apparatus of claim 38 wherein said wavelength converting
2	structure inc	ludes a periodically-poled ferroelectric crystal capable of performing
3	quasi-phaser	natching.
1	68.	The apparatus of claim 38 wherein said wavelength converting
2	structure inc	ludes lithium niobate.
1	69.	The apparatus of claim 38 wherein said wavelength converting
2	structure incl	ludes magnesium-doped lithium niobate.

1	70.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des congruent lithium niobate.
1	71.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des stoichiometric lithium niobate.
1	72.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des lithium tantalate.
1	73.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des magnesium-doped lithium tantalate.
1	74.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des congruent lithium tantalate.
1	75.	The apparatus of claim 38 wherein said wavelength converting
2	structure inclu	des stoichiometric lithium tantalate.
1	76.	The apparatus of claim 38 further including an electro-optic index
2	modulator pos	itioned near at least one of first waveguide and second waveguide, said
3	modulator serv	ring to control the optical path length of waveguides near said
4	modulator.	
1	ζ 77.	A polarization-insensitive integrated wavelength converter comprising:
2	a wave	length converter, having a gain level, for receiving said component
3	input signals and gene	rating component converted signals,
4	a polar	ization separator for separating an input signal into component input
5		onal polarization modes,
6	a polar	ization rotator for rotating the polarization modes of said component
7	input signal and optica	Il signal propagating through the polarization rotator, and
8		an interchannel crosstalk modulator, comprising a detector and
9	modulator stru	cture, serving to detect levels of interchannel crosstalk between
10		nverted optical signals whereby one or more of the amplitude of input
11		and converter gain level are modified accordingly to reduce
12	interchannel cr	

1	78. The apparatus of claim 77 wherein said wavelength converter includes
2	controls for modifying the gain level of at least of said converted signal, said input
3	signal and a pump signal.
1	79. The apparatus of claim 77 wherein said controls include an optical
2	parametric amplifier for providing said gain level.
1	80. The apparatus of claim 77 wherein said controls include an EDFA for
2	providing said gain level.
1	81. The apparatus of claim 77 wherein said controls include a pump diode for
2	providing said gain level.
1	82. The apparatus of claim 77 wherein said controls include a semiconductor
2	optical amplifier for providing said gain level.
1	83. The apparatus of claim 77 wherein said controls include an optical
2	attenuator.
1	84. The apparatus of claim 77 further including an optical filter structure for
2	discriminating between said input signals, said converted signals, pump signals and
3	non-converted signals.
1	85. The apparatus of claim 84 wherein said optical filter structure includes at
2	least one optical interleaver.
1	86. The apparatus of claim 84 wherein said optical filter structure includes at
2	least one arrayed waveguide.
1	9 87. A polarization-insensitive integrated wavelength converter comprising:
2	a wavelength converter having an input/output port;
3	a polarization separator having
4	a first port for receiving an input optical signal, optically
5	coupled to the input/output port of the wavelength converter,
6	a second port providing a first component of the input optical
7	signal in a first polarization mode, and

8			a third port providing a second component of the input optical
9			signal in a second polarization mode,
10			a wavelength converting structure having a first port and a second port,
11			said first port being coupled to the second port of the polarization
12			separator, serving to provide wavelength conversion on said input
13			optical signal,
14		a pola	rization rotator coupling the second port of the wavelength converting
15	structure to th	ne third	port of the polarization separator, serving to rotate the polarization of the
16	said input sig	nal.	
17	1	88.	A polarization-insensitive integrated wavelength converter comprising:
18		a pola	rization separator having two or more waveguides that support
19	orthogonal po	olarizati	on modes of an input signal,
20		a wav	elength converting structure, serving to provide wavelength conversion
21	on said input	optical	signal, a polarization rotator, serving to rotate the polarization of the said
22	input signal, a	and a co	oupler serving to optically couple said waveguides.
1	Ç	89.	A polarization-insensitive integrated wavelength converter comprising:
2		a wav	eguide that supports an input signal having a plurality polarizations,
3		a wav	elength converting structure, serving to provide wavelength conversion
4	on at least one	e polari	zation mode of said input optical signal, a polarization rotator, serving to
5	rotate the said	l plurali	ity of polarizations of the said input signal, and a reflector serving to
6	reflect said in	put sigi	nal back through said wavelength converting structure.
1	Ŷ	90.	A polarization-insensitive integrated wavelength converter comprising:
2		at leas	st one polarization splitter comprising a first waveguide that supports an
3	input signal h	aving a	plurality polarizations, and a second waveguide that supports at least
4	one polarizati	on mod	le of said input signal, a wavelength converting structure serving to
5	provide wave	length o	conversion on at least one polarization mode of said input optical signal,
6	and a polariza	tion ro	tator, serving to rotate the polarizations of said input signal in at least
7	one of first or	second	waveguides.
1	io	91.	A polarization-insensitive integrated wavelength converter comprising:
2		at leas	st one polarization splitter comprising a first waveguide that supports an
3	input signal h	aving a	plurality polarizations, and a second waveguide that supports one

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4	polarization mode of said input signal, a wavelength converting structure, serving to provide			
5	wavelength conversion on at least one polarization mode of said input optical signal, and a			
6	lens, wave plate and reflector assembly serving to optically couple said first and second			
7	waveguides.			
1	11 92. The apparatus of claim 91 wherein said wavelength conversion			
2	structure further comprises an optical frequency synthesizer, serving to provide frequency			
3	translation on said input signals.			
1 2 3 4	93. A polarization-insensitive integrated wavelength converter comprising: an optical circulator; a substrate; a waveguide, formed in said substrate, capable of supporting both TM and TE			
5	polarization modes and having first and second input/output ports;			
6	a polarization rotator region disposed at the second input/output port;			
7	a reflector coupled to said polarization rotator region; and a wavelength			
8	converter region formed in the waveguide.			
1 2 3	94. A polarization-insensitive integrated wavelength converter comprising: a substrate; a waveguide, formed in said substrate, capable of supporting both TM and TE			
4	polarization modes and having first and second input/output ports;			
5	a polarization rotator region disposed at the second input/output port;			
6	a reflector coupled to said polarization rotator region; and a wavelength			
7	converter region formed in the waveguide.			
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